PHILOSOPHICAL TRANSACTIONS.

XX. *On the Barometrical Variation as affected by the Moon's Declination.*
By LUKE HOWARD, *Esq., F.R.S.*

THESE calculations were begun with the year 1815, and continued to 1832: the present paper continues them to 1841. The method used to bring out the averages may be thus described. Beginning as nearly as may be at the winter solstice, the days of a solar year are classed in what may be termed *weeks of declination*, mostly of seven days each, the middle day of each week corresponding,—1, with the moon's position coming north from the equator; 2, with her position in full north declination; 3, with her position returning to south over the equator; 4, with her full south declination. The average, or mean height of the barometer, in each of these classes, is presumed to express the relative power, or effect, of the position to which it belongs; when divested of the much larger amount of variation due to the effect of a northerly or southerly current, of the variable pressure of the aqueous atmosphere, of the temperature of the season, the deposition of rain, &c. Mixed with *these*, the weekly averages offer a mass of results sufficiently discordant; but the discrepancy vanishes when those under each class are *averaged upon the solar year*; the other movements now balancing and neutralising each other.

The present series of averages extends then from December 20, 1832, where the former ends, to December 23, 1841. It corresponds nearly with the latter or *cold* half of the cycle of annual temperatures, which I have already laid before the public. And it being probable that a close connexion exists between the pressure and the temperature of the atmosphere of these latitudes, in its variations, my taking these limits may facilitate to students a careful comparison of the two, throughout a cycle.

In my paper of March 1841, the mean height of the barometer for each of the four positions came out, by averages upon eighteen years ending with 1832, as follows, viz.—

Moon coming north over equator . . . . . 29·8724 in.
Moon in north declination . . . . 29·8608 in.
Moon going over equator, south . . . . . 29·8450 in.
Moon in south declination . . . . 29·8261 in.

Hence it was inferred that the barometrical mean is *depressed* in these latitudes by the moon's position in south declination : and that which appeared upon the aggregate of years, was found to hold also in the several nine-years' averages of which it consisted. The depression was stated to be gradual, proceeding through the three changes to the south place ; but upon the planet's quitting her south position to return north, a sudden elevation of the mean, effected in a single week of declination, indicated the return of the pressure (as far as regarded *this* influence) to its former limit.

The results of the present examination differ somewhat in the proportions of pressure shown ; the chief cause being, as I apprehend, the different latitude in which a part of the observations took place. In 1828, near the middle of the year, having given up my house on Tottenham-green, I removed the barometer-clock to the Villa, Ackworth, Yorkshire, in latitude 53° 39' north, and still on the east side of the island. Here I obtained for some time the yearly circle of the variation : but coming subsequently to spend the winter in the south, from my absence joined with other causes, the clock for several months in the year stood still. I had presented a good barometer to the Friends' Institution at Ackworth, where a good meteorological register is kept at my instance ; and from *this* the maxima and minima, wanting in the series by the clock, have been taken.

Thus circumstanced, and the instrument standing, from the above date, on considerably higher ground, and 2° more to the north, the averages from 1824 to 1832 come out as follows, viz. moon coming north 29·8505 in. ; in north declination 29·8257 in. ; going south 29·8076 in. ; in south declination 29·8058 in. Here we have still the depression to the place of south declination ; but with a check, amounting almost to the doing of it away, in the concluding position. Let us, however, see further.

On the solar years, from 1833 to 1841, *observed wholly at Ackworth,* the averages are,—

> Moon coming north . . . . . 29·7127 in.
> Moon in north declination . . . 29·6946 in.
> Moon going south . . . . . 29·6969 in.
> Moon in south declination . . . 29·7115 in.

The former variation, presenting a gradual decline of gravity to the moon's south place, is here replaced by one altogether different ; the loss of gravity by the north declination continues into the following week, and is restored (very nearly) in the fourth week ; the moon yet full *south.* Had this discrepancy resulted from less perfect observation merely, it ought to have affected each position alike, and to have made the calculations useless ; but we have here even more of *symmetry* than before. There must be something then in the more northern latitude, affecting partially the *mixed* average 1824 to 1832, and more completely the *northern* average 1833 to 1841 ; which is commended, with all deference, to the study and consideration of our mathematical and astronomical Fellows.

In my former paper, I exhibited likewise a set of averages *upon the whole solar year,* from 1815 to 1832, in which the *yearly mean pressure* increases to the middle of a cycle of eighteen years, and then decreases with great regularity to its former amount. I have inserted here a similar calculation, but with an opposite result; which shows the pressure decreasing from year to year, and then recovering in some measure its former level : but this, for reasons already given, comes out less regular and symmetrical than the other. I have no doubt that, when we shall have prosecuted further the comparison of the yearly mean pressures with the temperatures, there will be found a contrast between the two halves of a cycle as evident as that I have shown to exist in those of the cycle of temperature.

In the long average, 1815 to 1841, we have,—1, a half cycle *cold*; 2, a half cycle *warm*; 3, a half cycle *cold*; the result of which must needs show a preponderance of the effect of cold. But let the temperatures balance, as in the cycle 1815–32, we have then—1, coming north 29·8310 in.; 2, north 29·8260 in.; 3, going south 29·8171 in.; 4, south 29·8056 in. Again, in the balanced cycle 1824–41, we have for the four respectively,—1, coming north 29·7816 in.; 2, north 29·7601 in.; 3, going south 29·7522 in.; 4, south 29·7586 in. The results of this last average are subject in some degree to the effect of a more northerly site. Without presuming to determine even that latitude has such an effect in a space of less than three degrees, I have thought it right to place these data in the hands of the Fellows, that future students may have the opportunity (now that we have begun to distinguish between the various causes affecting the gravity of the atmosphere) of comparing (with much trouble saved) the actual differences which obtain in it, under different positions of the planet; and of analysing, with the help of the register whence they are derived, a great mass of observations tending to throw light on the nascent science of meteorology.

I have to acknowledge, in concluding this paper, my obligations to my young friend CORNELIUS HANBURY, who made for me the preliminary calculations upon the register with much care, and, I am satisfied, with the required accuracy.

L. H.

Ackworth, October 25, 1844.

Barometrical Averages, &c.

Year.	Days.	Coming North.	North.	Going South.	South.	On the year.
		in.	in.	in.	in.	in.
1833.	369	29·5807	29·6497	29·5333	29·5812	29·5862
1834.	362	29·7733	29·6997	29·6653	29·6001	29·6846
1835.	368	29·8053	29·8507	29·8631	29·8659	29·8462
1836.	362	29·7749	29·4987	29·6004	29·6010	29·6187
1837.	369	29·7098	29·7588	29·6514	29·6595	29·6949
1838.	362	29·5696	29·7061	29·7283	29·6866	29·6702
1839.	368	29·7672	29·7347	29·7626	29·8158	29·7703
1840.	362	29·7851	29·7474	29·7724	29·8699	29·7932
1841.	369	29·6488	29·6055	29·6957	29·7139	29·6659
On nine solar years, 1833–1841.		29·7127	29·6946	29·6969	29·7115	29·7034

Years.	Coming North.	North.	Going South.	South.	On nine years.
	in.	in.	in.	in.	in.
1825–1833.	29·8063	29·7965	29·7812	29·7874	29·7928
1826–1834.	29·7719	29·7599	29·7448	29·7440	29·7552
1827–1835.	29·7403	29·7410	29·7306	29·7301	29·7355
1828–1836.	29·7223	29·6969	29·6896	29·6877	29·6991
1829–1837.	29·7057	29·6943	29·6732	29·6653	29·6846
1830–1838.	29·6930	29·6998	29·6779	29·6638	29·6836
1831–1839.	29·6960	29·7103	29·6782	29·6778	29·6906
1832–1840.	29·7126	29·7177	29·7007	29·7081	29·7098
1833–1841.	29·7127	29·6946	29·6969	29·7115	29·7039
On twenty-seven solar years, 1825–1841.	29·7290	29·7234	29·7081	29·7084	29·7172

Years.		Coming North.	North.	Going South.	South.	
		in.	in.	in.	in.	in.
1815–1823.	On nine years, the barom. at Tottenham..	29·8115	29·8263	29·8267	29·8054	
1824–1832.	On nine years, the barom. moved 1828.	29·8505	29·8257	29·8076	29·8058	
1833–1841.	On nine years, the barom. at Ackworth ..	29·7127	29·6946	29·6969	29·7115	
	Mean of the three	29·7916	29·7822	29·7771	29·7742	
				Mean of the whole....		29·7812

Barometrical Averages, &c.

Year and Periods.	Days.	Coming N.	Days.	North.	Days.	Going S.	Days.	South.
		in.		in.		in.		in.
Dec. 20–26, 1832	....	....	....	....	....	....	7	29·5243
Dec. 27 to Jan. 22, 1833.	7	29·7886	6	30·2941	7	29·9000	7	30·1257
Jan. 23 to Feb. 18	7	29·7621	7	29·1871	6	29·2008	7	29·0021
Feb. 19 to March 18	7	29·4257	7	29·1750	7	29·9757	7	29·4300
March 19 to April 14 ..	7	29·7528	6	29·5566	7	29·3500	7	29·3143
April 15 to May 12	7	29·5621	7	29·7578	6	29·4266	8	29·8443
May 13 to June 8	6	29·7583	7	29·9700	6	29·9425	8	29·5206
June 9 to July 5	7	29·4278	6	29·5908	7	29·4371	7	29·6064
July 6 to August 1	7	29·6471	7	29·7207	6	29·5450	7	30·0657
August 2–29	7	29·8978	7	29·5928	6	29·4733	8	29·6631
August 30 to Sept. 25 ..	7	29·5185	6	29·7358	7	29·5121	7	29·5678
Sept. 26 to Oct. 22	7	29·7193	7	29·8985	6	29·3600	7	29·1928
Oct. 23 to Nov. 18	7	29·4064	6	29·5935	7	29·5966	7	29·8314
Nov. 19 to Dec. 16	7	29·4021	7	29·3735	7	29·2128	7	29·4478
December 17–23	7	29·0607						
369 days.	97	29·5807	86	29·6497	85	29·5333	101	29·5812
Dec. 24, 1833 to Jan.12, 1834	....	....	7	29·3893	6	29·6225	7	29·0400
January 13 to February 8.	7	29·2743	7	29·4314	7	29·6665	6	29·7358
February 9 to March 7 ..	8	29·9112	6	29·7541	7	29·9107	6	29·6891
March 8 to April 4	8	30·1481	7	30·1021	6	29·5241	7	29·8421
April 5 to May 1	7	30·0693	7	30·0500	7	30·0064	6	29·3016
May 2–28	8	29·7243	6	29·5083	7	29·6950	6	30·0875
May 29 to June 25	8	29·7450	6	29·4983	7	29·4121	7	29·7314
June 26 to July 22	7	29·9200	7	29·7371	7	29·6593	6	29·4933
July 23 to August 19 ..	8	29·6331	6	29·5483	7	29·6150	7	29·7386
August 20 to Sept. 15 ..	7	29·4207	6	29·4258	7	29·5286	7	29·7578
Sept. 16 to Oct. 12......	7	29·8907	7	29·7886	6	29·8091	7	29·6936
Oct. 13 to Nov. 8	7	29·3236	7	29·6564	7	29·8757	6	29·2058
Nov. 9 to Dec. 6	7	29·9678	8	29·7675	6	29·3233	7	29·4850
December 7–20	7	30·0243	7	30·1393				
362 days.	96	29·7733	94	29·6997	87	29·6653	85	29·6001
Dec. 21, 1834 to Jan. 2, 1835	....	....	....	....	7	30·0643	6	29·8567
January 3–29	7	29·9671	7	29·4850	7	29·7264	6	30·1666
January 30 to February 25.	7	30·0557	8	29·9831	6	29·3791	6	29·1775
February 26 to March 25.	8	29·5162	7	29·4271	7	29·9464	6	30·3758
March 26 to April 21 ..	7	29·9807	7	30·1186	7	30·1214	6	30·2541
April 22 to May 19	8	29·9812	7	29·7278	6	29·7283	7	29·7500
May 20 to June 15	6	29·9008	8	29·9106	6	29·9558	7	30·2786
June 16 to July 12	7	29·9078	7	29·7628	7	29·9678	6	29·7733
July 13 to August 8	7	29·8571	8	30·1987	6	30·0375	6	29·9716
August 9 to September 5.	8	30·0769	7	29·8207	6	29·7808	7	30·0129
September 6 to October 2.	7	29·4550	7	29·5750	7	29·5700	6	29·1733
October 3–29	7	29·5417	7	29·8793	7	29·7829	6	29·5425
October 30 to Nov. 26 ..	7	30·0121	8	30·1881	6	29·8450	7	29·5571
November 27 to Dec. 23.	7	29·2164	7	29·9821	7	30·1786	6	30·2325
368 days.	93	29·8053	95	29·8507	92	29·8631	88	29·8659

Barometrical Averages, &c.

Year and Periods.	Days.	Coming N.	Days.	North.	Days.	Going S.	Days.	South.
		in.		in.		in.		
Dec. 24, 1835 to Jan. 19, 1836	7	30·1350	7	30·1007	7	29·4714	6	29·9450
Jan. 20 to Feb. 16	7	29·6457	7	29·0393	7	29·7700	7	30·0293
February 17 to March 14	6	30·0133	7	29·0414	8	29·2000	6	28·9300
March 15 to April 10	7	29·7564	7	29·0671	7	29·6335	6	29·3508
April 11 to May 8	7	29·7843	8	29·7244	6	29·7300	7	29·9786
May 9 to June 4	6	30·1391	8	30·0775	7	30·1714	6	29·5825
June 5 to July 1	6	29·5066	8	29·6937	7	29·6243	6	29·7741
July 2–28	7	29·9357	7	29·5807	7	29·4935	6	29·6441
July 29 to August 25	7	29·7300	8	30·0175	7	29·7607	6	29·6450
August 26 to Sept. 21	6	29·7225	8	29·3287	7	29·8807	6	29·8816
Sept. 22 to October 18	7	29·6143	7	29·1050	7	29·0200	6	29·7158
Oct. 19 to Nov. 15	7	30·0757	8	29·6481	6	29·6116	7	29·3857
Nov. 16 to Dec. 12	6	29·3076	8	29·0594	7	29·4378	6	28·9508
December 13–19	7	29·4828						
362 days.	93	29·7749	98	29·4987	90	29·6004	81	29·6010
Dec. 20, 1836 to Jan. 8, 1837	....	....	7	29·8028	7	30·0964	6	29·8558
Jan. 9 to Feb. 5	7	29·7293	8	29·8131	7	29·6328	6	30·0025
Feb. 6 to March 4	7	29·4414	7	29·3878	7	29·4893	6	29·9933
March 5–31	7	29·6178	7	29·9378	7	29·5564	6	29·5491
April 1 to 28	7	29·5535	7	29·7250	7	29·4550	7	29·3750
April 29 to May 25	7	29·4535	7	29·5757	7	29·8385	6	29·5741
May 26 to June 21	7	29·6471	7	29·7700	7	29·4428	6	29·5775
June 22 to July 19	7	29·9214	7	29·8828	7	29·8285	7	29·4764
July 20 to August 15	7	29·6957	6	29·2683	8	29·9118	6	30·0016
August 16 to Sept. 11	7	29·6578	7	29·8621	7	29·5843	6	29·6491
Sept. 12 to October 9	7	29·5714	7	30·1271	7	30·0593	7	30·0228
October 10 to Nov. 5	7	30·1714	6	29·9350	7	29·1971	7	29·0793
November 6 to Dec. 2	7	29·7257	7	29·5578	7	29·3657	6	29·4166
December 3–23	7	30·0418	6	29·9775	8	29·6618		
369 days.	91	29·7098	96	29·7588	100	29·6514	82	29·6595
Dec. 24–30, 1837	....	29·8166	....	....	....	....	7	29·7128
Dec. 31 to Jan. 26, 1838	6	29·8166	7	30·2093	8	29·9450	6	29·6275
Jan. 27 to Feb. 22	7	29·7735	7	29·6257	7	29·5421	6	29·7900
Feb. 23 to March 22	7	29·0107	6	29·4400	8	29·9170	7	29·3164
March 23 to April 18	6	29·9400	7	30·0471	7	29·6014	7	29·7335
April 19 to May 15	7	29·5357	6	29·6825	8	30·0125	6	29·5541
May 16 to June 11	7	29·3178	6	29·5433	8	29·4331	6	29·5325
June 12 to July 9	7	29·4364	7	29·4621	7	29·5914	7	29·6164
July 10 to August 5	7	29·4643	6	29·6758	7	29·6593	7	29·5485
August 6 to Sept. 1	7	29·7471	7	29·9114	7	29·4707	6	29·9083
September 2–29	7	29·5743	7	30·1450	7	29·8107	7	29·8071
Sept. 30 to October 26	6	30·3225	7	29·9721	7	29·4271	7	29·7535
October 27 to Nov. 22	7	29·2678	6	29·1391	7	29·8557	7	29·5221
November 23 to Dec. 20	7	29·1985	6	29·3266	8	30·2018	7	30·1907
362 days.	88	29·5696	85	29·7061	96	29·7283	93	29·6866

Barometrical Averages, &c.

Year and Periods.	Days.	Coming N.	Days.	North.	Days.	Going S.	Days.	South.
		in.		in.		in.		in.
Dec. 21, 1838 to Jan. 16, 1839..........	7	29·6593	6	30·0075	7	29·3828	7	29·8335
Jan. 17 to Feb. 12	6	29·7066	7	30·0500	7	29·7338	7	30·1707
Feb. 13 to March 12....	7	29·5764	7	29·7157	7	30·0678	7	29·9528
March 13 to April 8	6	29·6983	7	29·5778	7	29·5364	7	30·1393
April 9 to May 6	7	30·3028	6	29·6591	7	30·0828	8	29·8706
May 7 to June 2	6	30·0133	7	29·7085	6	30·0375	8	30·0875
June 3–29	6	29·7108	7	29·9914	7	29·7457	7	29·6343
June 30 to July 26	6	30·0841	7	29·5835	7	29·6671	7	29·6221
July 27 to August 22 ..	7	29·6443	6	29·9141	7	29·8235	7	29·9007
August 23 to Sept. 19 ..	7	29·7293	7	29·2593	7	29·6635	7	29·1814
Sept. 20 to October 16 ..	6	29·5291	7	29·6064	7	29·8650	7	29·7078
October 17 to Nov. 13 ..	7	29·9271	6	30·3333	7	29·8193	8	29·5800
Nov. 14 to Dec. 10	6	29·7666	6	29·7033	8	29·4881	7	29·9250
December 11–23	7	29·3928	6	29·1758				
368 days.	91	29·7672	92	29·7347	91	29·7626	94	29·8158
Dec. 24, 1839 to Jan. 6, 1840.	..	....	..	....	7	29·6443	7	29·8007
Jan. 7 to Feb. 2........	7	30·1457	6	29·5441	7	29·1057	7	29·3843
Feb. 3 to March 1......	7	29·2600	6	29·6741	7	30·2893	8	30·4575
March 2–28	6	30·5041	6	30·3100	8	30·1956	7	30·1607
March 29 to April 24 ..	7	29·8300	6	29·9783	7	30·0000	7	30·1857
April 25 to May 22	7	30·2485	6	29·9866	7	29·5728	8	29·8018
May 23 to June 18	7	29·8378	6	29·9566	6	29·8183	8	29·6793
June 19 to July 15	7	29·7450	6	29·8216	7	29·4428	7	29·9164
July 16 to August 11 ..	7	29·5493	6	29·7825	7	30·0328	7	29·8500
August 12 to Sept. 8....	7	29·3700	7	29·7614	6	29·9975	8	29·7575
Sept. 9 to October 5....	6	29·5616	7	29·5057	7	29·5185	7	29·9457
October 6 to Nov. 1	7	30·2550	6	29·8550	7	29·7407	7	29·2628
November 2–29........	7	28·8143	6	29·7575	7	29·4371	8	30·1068
Nov. 30 to Dec. 19.	7	30·0857	6	29·7833	7	30·0185		
362 days.	89	29·7851	80	29·7474	97	29·7724	96	29·8699
Dec. 20–26, 1840	..	....	..	....	..	....	7	30·2678
Dec. 27, 1840 to Jan. 22, 1841..........	7	30·0185	6	29·4708	7	29·3257	7	29·8750
January 23 to Feb. 18 ..		30·0085	6	30·1100	7	29·7057	7	29·3535
February 19 to March 18.	7	30·0443	6	29·5758	6	30·0541	8	29·8550
March 19 to April 14 ..	7	29·5207	6	29·5158	7	29·4850	7	29·7793
April 15 to May 11	7	29·7350	6	29·6400	7	29·7907	7	29·6650
May 12 to June 8	7	29·7293	7	29·7757	6	29·9175	8	30·0050
June 9 to July 5	7	29·8428	6	29·6700	7	29·6671	7	29·8614
July 6 to August 1	7	29·5471	6	29·6833	7	29·7371	7	29·6093
August 2–28	7	29·5057	7	29·5414	6	29·8050	7	29·9543
August 29 to Sept. 25 ..	8	29·6656	6	29·7008	7	29·7850	7	29·6114
Sept. 26 to Oct. 22	7	29·2443	6	29·0675	7	29·4378	7	29·5014
October 23 to Nov. 18 ..	7	29·3571	7	30·0778	6	29·9675	7	29·2857
Nov. 19 to Dec. 15	8	29·4881	6	29·0433	7	29·3657	6	29·3708
December 16–23	8	29·3762						
369 days.	102	29·6488	81	29·6055	87	29·6957	99	29·7139